

The following claims are therefore made:

1. A revolutionary method of optimizing the optical system design to reduce the cost and size of the system comprising :
Relaxing the aberration specifications of the lens, thus reducing the number of lens which leads to less cost and smaller size.
Measure the Point-Spread-Function of some sample point objects with equal illuminations, and extract the aberration information of the lens.
Store the extracted aberration information of the lens in the image chip. Use some mathematical algorithm to process the raw image sensed by the image chip, thus creating the image with the lens aberrations corrected.
2. The method described in item 1. can also be used to build higher resolution optical systems using existing lower resolution lens. Simply measure the Point-Spread-Function of some sample point objects with equal illuminations, and extract the aberration information of the lens. Then store the aberration information of the lens in the image chip. Use some mathematical algorithm to process the raw image sensed by the image chip, thus creating the image with the lens aberrations corrected.
3. The above mentioned method can also be used to process the images taken by existing optical systems like digital camera etc. to get rid of some lens aberrations. Take the images of some sample point objects with equal illumination, which can be used to extract the aberration information of the lens. And use the same mathematical algorithm mentioned in items 1. & 2 to correct the lens aberrations.
4. The method of "Measure the Point-Spread-Function of some sample point objects with equal illumination" mentioned in item 1. & 2. refers to taking the images of some pre-designed point light sources with equal illumination using high resolution image chips. This is done for three colors: Red, Green and Blue.
5. One proposed set-up of the "point objects with equal illumination" or "point light sources with equal illumination" mentioned in items 1. to items 4 is shown in **Fig. 3 & 4** . Use uniform collimated light source to shine on an opaque plate with hole patterns.

6. The hole size of the “opaque plate with hole patterns” mentioned in item 5 should be small enough so that the central bright spot of its image is less than the pixel size of the image chip.
7. The hole separations of the “opaque plate with hole patterns” mentioned in item 5 are smaller as the holes are further away from the center of the plate. This is because the distortions are bigger as the point object is further away from the center. Therefore, more data points are needed to extract the Point-Spread-Function.
8. The “mathematical algorithm” mentioned in items 1 to 3 refers to the **formulae 3 & 4** in the “summary of invention” section. Where vector **I** is the illuminations of all the image pixels, **O** is the illuminations of all the object light sources, and **S** is the matrix describing the transformation of images. The **S** matrix is determined from the images of the “sample point objects” described in items 4 to 7.
9. The **S** matrix mentioned in item 8 is constructed as follows: As illustrated in the “Summary of Invention” section, each column of the **S** matrix corresponds to the Point-Spread-Function of one point object. Since there are only a limited number of sample point light sources in the “opaque plate” mentioned in items 5 to 7, the Point-Spread-Functions in the rest of the matrix can be constructed using linear extrapolating, that is, it can be taken as the average of the surrounding points.
10. The inverse **S** matrix S^{-1} mentioned in item 8 will be saved in the image chips using non-volatile memory. The data is written during the final optical system test (with lens and image chips integrated).
11. Another proposed set-up of measuring the Point-Spread-Function of the lens consisting of taking the images of some uniformly separated circular light sources using high resolution image chips. This is done for three colors: Red, Green and Blue.
12. One example of "taking the images of some uniformly separated circular light sources using high resolution image chips" mentioned in item 1. is shown in Fig. 5. In which the light sources have separations of " L_o " and radius " R_o ", while their images have separations of " L_i " and radius " R_i ".

13. The Point-Spread-Function can be approximated by a circular distribution with a radius ϵ as shown in Fig 6. Where the function can be a linear function, gaussian or sine, or other similar decaying functions.
14. The "radius ϵ " of the Point-Spread-Function mentioned in item 13 can be calculated using the measured data in item 12. according to the formular:

$$\epsilon = R_i - (L_i/L_o) * R_o$$

Averages can be taken to make a more accurate extraction of ϵ